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Underwater annular irradiance: New concept to measure the light diffuse attenuation coefficient through the KduSTICK, a Do-It-Yourself device

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Measuring water transparency allows us to monitor the water body's environmental status. One parameter to estimate water transparency is the light diffuse attenuation coefficient (K_d). This coefficient is of particular interest in water quality monitoring programs.

The K_d describes the light extinction as function as the depth of downwelling irradiance, E_d . However, self-shading by the instrument itself can cause errors in E_d estimations. To avoid this effect, relative complex structures must be required to install the sensors that limit the vertical resolution of E_d measurements. Here we propose to use optical sensors in an annular-shape distribution to mitigate these limitations. For this, we introduce a new concept: the annular irradiance, E_a . We first compute the optimal angle to avoid self-shading while maximizing the light captured by the sensor. Second, we assess the robustness of the corresponding diffuse attenuation coefficient, K_a , in different scenarios of water types, solar angle and cloud coverage. Finally, we correlate K_a measurements with K_d at PAR region, and we derive empirical functions from translating K_a to K_d measurements.

This new coefficient is the basis of the new generation of the KduINO instrument (Bardaji et al., 2016) as a KduSTICK, which estimates the near-surface light extinction coefficient based on K_a measurements. Since the design of the instrument avoids self-shading, the device is expected to be particularly useful in those underwater environments where high vertical E_d resolution is required.

Furthermore, instruments based on this light-sensing approach are much simpler to deploy and maintain, and it is possible to design low-cost and Do-It-Yourself (DIY) versions. All these features facilitate its use for non-academic users, making the KduSTICK an optimal instrument to be used in Citizen Science water quality monitoring programs.